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Discussions

Interactive comment on "Does the Budyko curve reflect a maximum power state of hydrological systems? A backward analysis" *by* M. Westhoff et al.

Anonymous Referee #1

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General remarks:

The manuscript presents a derivation of the gradients driving evapotranspiration and runoff based on the maximum power principle and the Budyko curve. It is an interesting concept, to use the Budyko curve not as an evaluation criterion, but instead as an additional constraint in the optimisation procedure, and I think this is in principle suitable for publication. The manuscript, however, could be much more clear on the goals of the optimisation. In particular, it should be made clear that the authors do not really predict "the Budyko curve", but rather the shape of the gradient functions and the value of conductances. The Budyko curve is used as a constraint. I suggest that several parts

are extended (see below) to make the study comprehensible also for readers who are not familiar with the maximum power principle.

Detailed comments:

p7822,l9 "...the asymptotes closely." - please add a short sentence why you did that.

p7822,l12 I guess it should be "sensitivity OF the model TO dry spells..."

p7822,l15 This should be more specific, the Budyko curve itself is not "derived" here, it is prescribed in Eq. 9

p7823,l23 "...coincidence." - could you please add one or two recent references for the debate?

p7826,l6 Please use "t" instead of "T" for time.

p7827,l21 There should be an additional remark here that, consequently, the model ignores the influence of radiation on evapotranspiration. This is important, since some established approaches (e.g. equilibrium evapotranspiration) assume the opposite.

p7828,l5 This is quite difficult to comprehend: Power is defined as flux times gradient (Eq. 3), hence I assume the authors are looking for a function "G" so that dP/dk=0 etc. The way this is described here sounds like the expression for power could take on any form. This is not correct, it is the expression for G that is assumed to be flexible, which I am ok with, and resulting from the form of G, the corresponding power is maximised. The authors should make this part more clear, maybe rearrange the equations 11-13.

p7830,l11 I would rather say, Gr is a linear function of h, that fits better to Eq. 19

p7831,l21 The authors should shortly explain here why they did not include the parameter n in the optimisation. This would have been a real step to "move away from empiricism".

p7831,l22 I would like to know why the authors did not additionally use a very small

HESSD

12, C3662–C3664, 2015

value of n for the initial curve and started from there. Is it only possible for the slope of the curve to decrease and, if so, why?

p7834,l17 I am not sure if using a large value for n really corresponds to an "uncalibrated" Budyko model. As the authors state, a large n reflects the asymptotes of the Budyko curve, and therefore corresponds to the energetic and mass constraints of the Budyko model. An uncalibrated version of the Budyko curve would, in my opinion, rather be associated with an unknown value of n, treating n as a free parameter.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 7821, 2015.